Assessment of 10 Year Record of Aerosol Optical Depth From OMI UV Observations

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Sept15 - 18, 2014, Aura Science Team Meeting

Background

The Ozone Monitoring Instrument (OMI) onboard the EOS-Aura satellite provides information on aerosol optical properties by making use of the large sensitivity to aerosol absorption in the near-ultraviolet (UV) spectral region. Another important advantage of using near UV observations for aerosol characterization is the low surface albedo of all terrestrial surfaces in this spectral region that reduces retrieval errors associated with land surface reflectance characterization. In spite of the 13 × 24 km^2 coarse sensor footprint, the OMI near UV aerosol algorithm (OMAERUV) retrieves aerosol optical depth (AOD) and single-scattering albedo under cloud-free conditions from radiance measurements at 354 and 388 nm. We present validation results of OMI AOD against space and time collocated Aerosol Robotic Network measured AOD values over multiple stations representing major aerosol episodes and regimes. OMAERUV's performance is also evaluated with respect to those of the Aqua-MODIS Deep Blue and Terra-MISR AOD algorithms over arid and semi-arid regions in Northern Africa. The outcome of the evaluation analysis indicates that in spite of the "row anomaly" problem, affecting the sensor since mid-2007, the long-term aerosol record shows remarkable sensor stability.

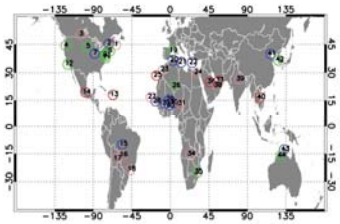
Reference : "Assessment of OMI near-UV Aerosol Optical Depth over Land", Changwoo Ahn, Omar Torres, and Hiren Jethva, *Journal of Geophysical Research - Atmospheres*, 10.1002/2013JD020188.

Information of AOD Data Sets

Sensor Name	Version No.	Meaning of AOD Quality Assurance (QA) Flags
OMI-NASA (OMAERUV)	version 1.4.2	QA Flag 0 (= most reliable retrievals)
AERONET	version 2.0	Level 2.0 (= cloud screened and calibrated)
Aqua/MODIS Deep Blue	collection 5.1	QA Flag 3 (= very good confidence)
Terra/MISR	version 22	QA Flags 0 and 1 (= successful aerosol mixtures)
OMI-KNMI (OMAERO)	version 1.2.3.1	No QA Flags

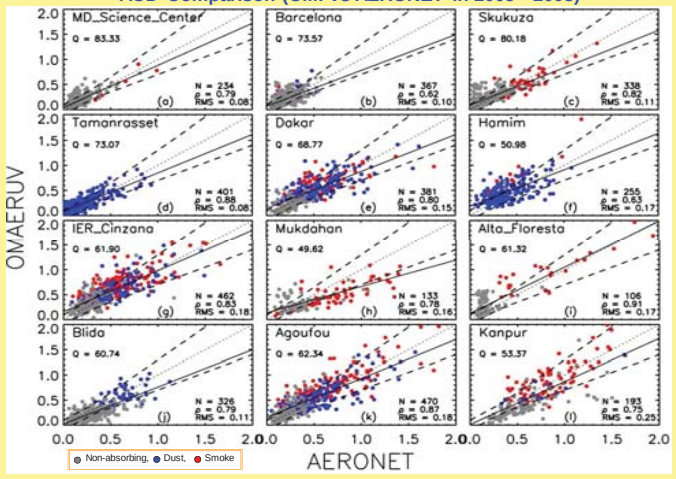
AOD Collocation Method

- Within a radius of 40 km and ± 10 min window of the OMI overpass at 44 AERONET sites globally distributed over lands.
- Discard large standard deviations of OMI (> 0.3) daily matchups roughly corresponding to 3 % extreme outliers out of total collocated pairs at 44 sites over 4 years (2005 – 2008).
- The same collocation rules are applied to other data sets (i.e., MODIS, MISR, and KNMI).



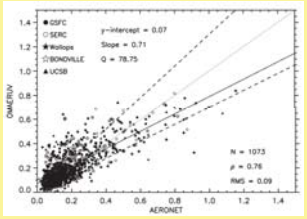
- Global locations of the selected 44 AERONET sites for comparisons with OMI AOD. Colors indicate the percent (Q) of daily OMI-matched AOD values falling within the uncertainty envelope of ± 30% or 0.1 AOD
- **Green circle: Q ≥ 70%**
- **Blue circle: 60% ≤ Q < 70%**
- **Pink circle: 50% ≤ Q < 60%**
- **Red circle: Q < 50%**

AOD Comparison (OMI vs AERONET in 2005 - 2008)



- N : Total number of daily match-ups for 2005 - 2008.
- Q = Percent of match-ups within ± 30 % or 0.1 AOD uncertainty limits.
- RMSE = SQRT[SUM (Y – LinearFitted Y)^2 / N]. Y is the OMI observation, X is the AERONET measurement.
- y-intercept and slope from a linear fit.
- ρ = Correlation Coefficient.

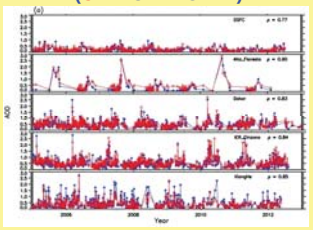
OMI vs AERONET for Typical Non-Absorbing Scattering Aerosols (2005 -2008)



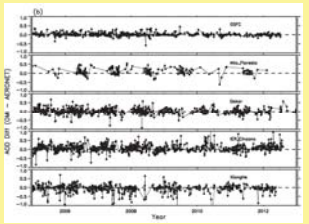
Conclusions

- The UV aerosol technique is able to retrieve reliable scattering aerosol optical depths provided that a reasonable cloud screening information is available.
- Overall OMI AOD from all 44 sites is in good agreement with AERONET AOD, showing descent statistics : N = 10134, RMSE= 0.16, ρ = 0.81, and the percent of OMI AOD values fell within the uncertainty envelope of ± 30 % or 0.1 AOD is 64.93 %.
- OMI performs well to be comparable to the MODIS Deep Blue and MISR, with relatively more availability of the good quality AOD over dust and biomass dominant sites.
- Some of poor results appear to be associated with the remaining algorithm issues such as the inaccurate characterization of surface albedo, aerosol models, and/or inadequate flagging scheme of the data quality assurance (QA).
- The OMAERUV 10-year global aerosol record is publicly available at the NASA data service center web site (http://disc.sci.gsfc.nasa.gov/Aura/data-holdings/OMI/omaeruv_v003.shtml).

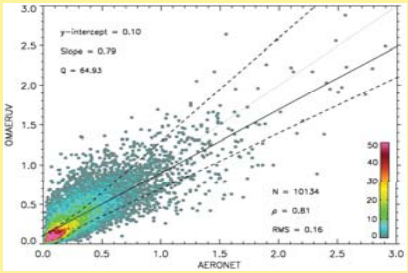
AOD Time Series (OMI vs AERONET)



AOD Difference (OMI – AERONET) Time Series

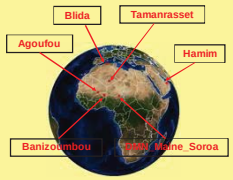


OMI vs 44 AERONET Sites (2005 – 2008)

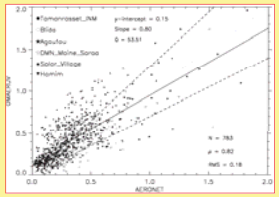


The color bar represents the number of pairs for each bin with the interval of 0.02 AOD where the minimum number of pairs (1.0) is shown in gray color. The maximum number of pairs between 50 and 110 is shown in pink.

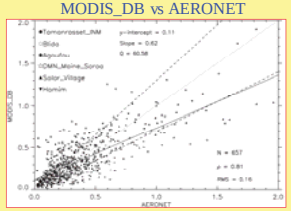
AOD Intercomparison Over Dust and Biomass Burning Dominant Sites in 2007



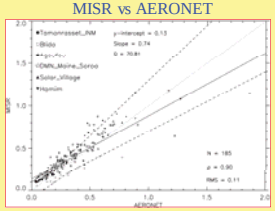
OMI-NASA vs AERONET



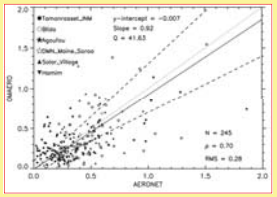
MODIS_DB vs AERONET



MISR vs AERONET



OMI-KNMI vs AERONET



ACKNOWLEDGEMENTS

We thank the NASA data centers for providing AOD data from OMI (http://disc.sci.gsfc.nasa.gov/Aura/data-holdings/OMI/omaeruv_v003.shtml/), MODIS (http://ladsweb.nascom.nasa.gov/data/search.html), and MISR (http://eosweb.larc.nasa.gov/PRODOCS/misr/table_misr.html) sensors. We also thank the AERONET principal investigators for theirs efforts in establishing and maintaining the sites that make it possible to evaluate satellite AOD values in this intercomparison study. This work was performed under contract with NASA.